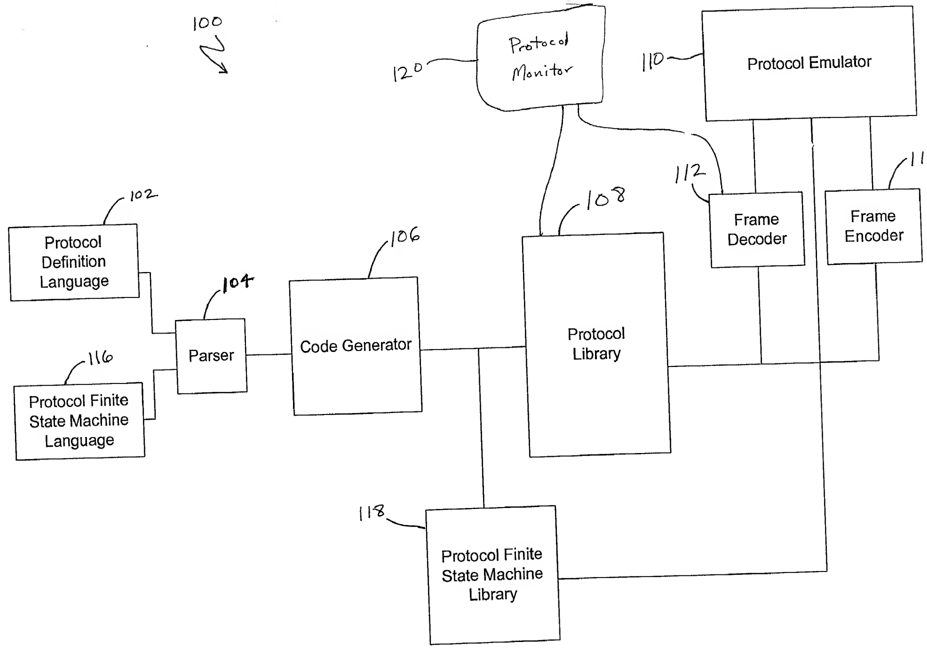
FIG. 1



100
120
Protocol Monitor
110
Protocol Emulator
112
114
102
108
Protocol Definition Language
106
104
Frame Decoder
Frame Encoder
Parser
Code Generator
Protocol Library
116
Protocol Finite State Machine Language
118
Protocol Finite State Machine Library

FIG. 2 (prior art)

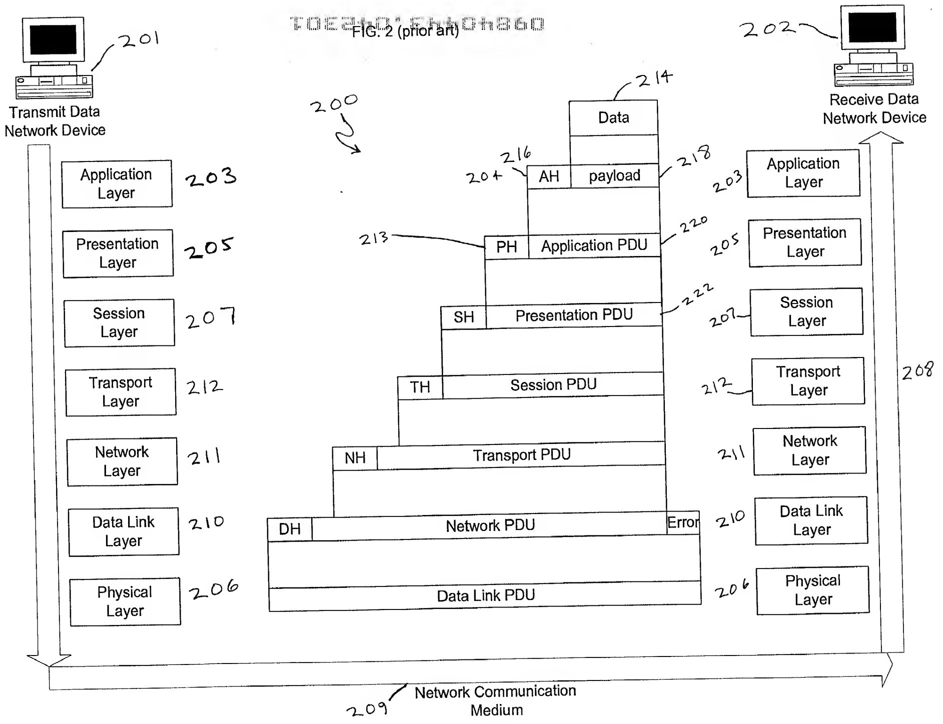


FIG. 3 (prior art)

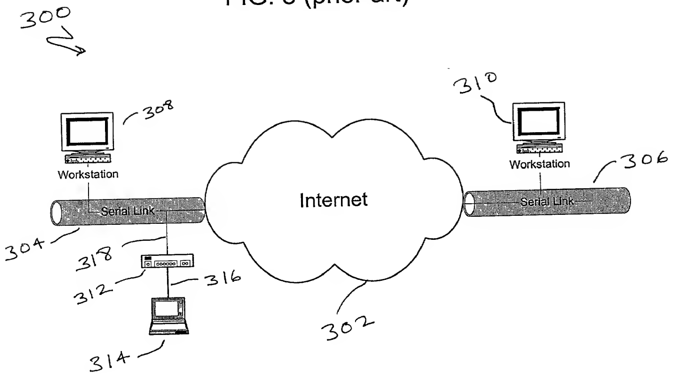


FIG. 4 (prior art)

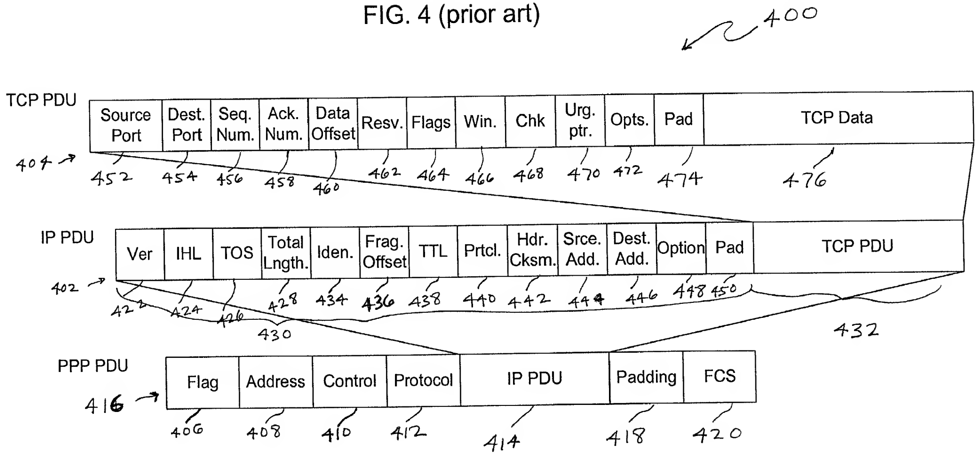
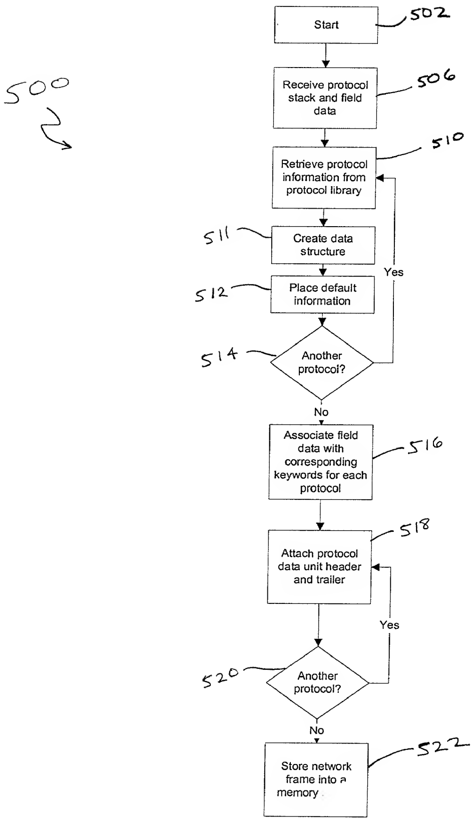


FIG. 5



500
Start
502
Receive protocol stack and field data
506
Retrieve protocol information from protocol library
510
511
Create data structure
Yes
512
Place default information
514
Another protocol?
No
Associate field data with corresponding keywords for each protocol
516
518
Attach protocol data unit header and trailer
Yes
520
Another protocol?
No
Store network frame into a memory
522

FIG. 6

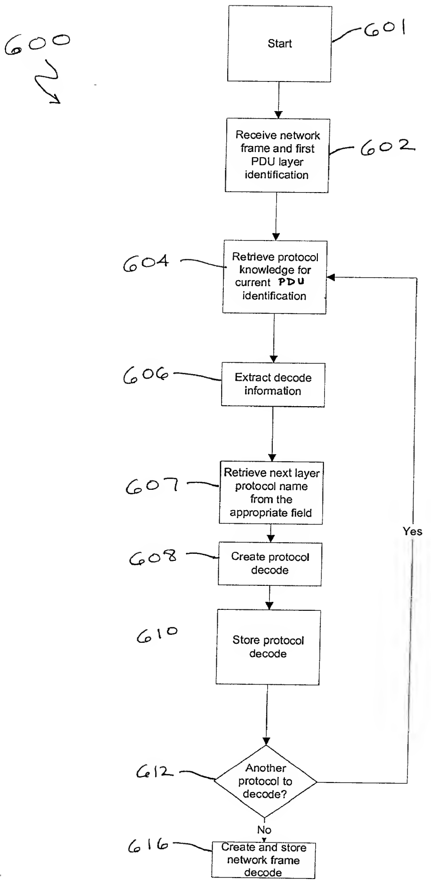

600
Start
601
Receive network frame and first PDU layer identification
602
604
Retrieve protocol knowledge for current PDU identification
606
Extract decode information
607
Retrieve next layer protocol name from the appropriate field
608
Create protocol decode
610
Store protocol decode
612
Another protocol to decode?
Yes
No
616
Create and store network frame decode

FIG. 7

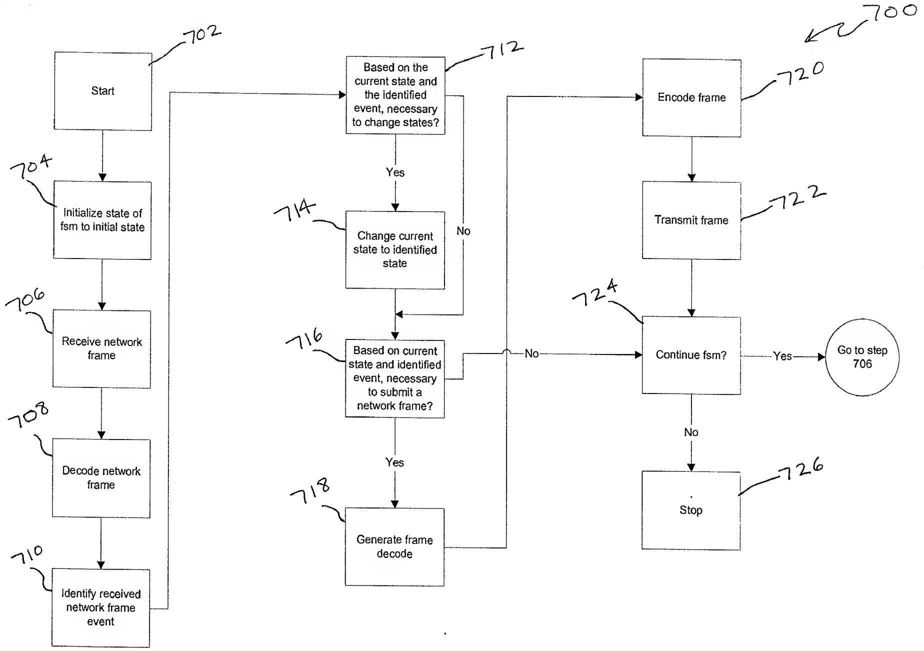

700
Start
702
Initialize state of fsm to initial state
704
Receive network frame
706
Decode network frame
708
Identify received network frame event
710
Based on the current state and the identified event, necessary to change states?
712
Yes
No
Change current state to identified state
714
Based on current state and identified event, necessary to submit a network frame?
716
Yes
No
Generate frame decode
718
Encode frame
720
Transmit frame
722
Continue fsm?
724
Yes
Go to step 706
No
Stop
726

FIG. 8A

```
      protocol "IP" {//-------------------------------------------------------
802            len=valueof(field "Total Length")*8
               minLen=20*8  //just header
804            maxLen=65535*8
         header "IP Header"
806            payload "IP Payload"
808

        header "IP Header"  {//---------------------------------------------
810  812
          len=valueof(field "Header Length")*32
      816 field "Version"
     818  field "Header Length"
     814  compound_field "Type Of Service"
     824  field "Total Length"

 820  field "Identification" {len=16 default=291}
 815  compound_field "Flags"
 822  field "Fragment Offset" {len=13  desc="in 64 bits units"}
 826  field "Time To Live" {len=8 default=30 desc="seconds"}
 828  field "Protocol"
 830  field "Header Checksum"
 832  field "Source IP Address" {len=32 display=ipv4  field_type=must_encode}
 834  field "Destination IP Address" {
                   len=32
                   display=ipv4
                   field_type=must_encode
           }

 816  repeat {
           len = (valueof (field "header Length") - 5 )*32 // includes padding
         compound_field "Options"
      }


        field "Version" {
                 len=4
                 default=4
                 possible_values={
            0,15:"Reserved"
            1-3: "Unassigned"
                  6-14:"Unassigned"
            4:"IP Internet Protocol"
            5:"ST ST Datagram Mode"
        }}
```

FIG. 8B

```
field "Header Length" {
        len=4
        minValue=5
        desc="in 32 bit units"
        default=eval_fn(len, "IP", "IP Header", "/32")
}

field "Total Length" {
        minValue=20
        len=16
        desc="in octets include header length"
        default=eval_fn(len, "IP", "IP", "/8")
}


  field "Header Checksum" {
        len=16
        default=eval_fn(checksum, "IP", "IP Header")
        display=hex
}

compound_field "Type Of Service" { //---------------------------------
        display=hex
        field "precedence" {
        len=3
        possible_values={
0:"Routine"
1:"Priority"
2:"Immediate"
3:"Flash"
4:"Flash override"
5:"CRITIC/ECP"
6:"Internetwork Control"
7:"Network Control"
}}

field "Delay" {
len=1
        possible_values={0:"normal" 1:"low"}}

field "Throughput"   {
        len=1
possible_values={0:"normal" 1:"high"}}

field "Reliability" {
        len=1
```

FIG. 8C

```
        possible_values={0:"Normal" 1:"High"}}

        field "Monetary Cost" {
                len=1
        possible_value={0:"normal" 1:"low"}}


        field "Unused" {
                len=1
                possible_values={0:"Valid"}}

        }// end of field "type of service" ------------------------------------

        compound_field "Flags" {

                len=3
                display=hex
        field "Reserved" {
                        len=1
                        possible_values={0:"Valid"}}

            field "Fragment" {
                        len=1
                        possible_values={0:"May Fragment" 1:"Don't Fragment"}}
            field "Fragments" {
                        len=1
                        possible_values={0:"Last" 1:"More"}}
        }


compound_field "Options" {//----------------------------------------------

    optional = (valueof (field "Header Length") > 5)
    compound_field "Option Tuple"
    {
     len = 8;
     display=hex
     field "Copied Flag" {
                len=1
                possible_values={
             0:"not copied into all fragments on fragmentation"
       1:"copied into all fragments on fragmentation"
    }}

    field "Option Class" {
                len=2
```

FIG. 8D

```
                possible_values={
                0:"control"
    1:"reserved for future use"
                2:"debugging and measurement"
                3:"reserved for future use"
}}

field "Option Number" {
                len = 5
                field_type = mulopt_other_fld
                possible_values={
            0:"End of Option list"
      1:"No Operation"
            2:"Security"
            3:"Loose Source Routing"
      4:"Internet Timestamp"
            7:"Record Route"
      8:"Stream ID"
            9:"Strict Source Routing"
}}
}

switch(valueof(field "Option Number")){
  0:null
  1:null
  2:compound_field "Security"
  3:compound_field "Loose Source Routing"
  9:compound_field "Strict Source Routing"
  7:compound_field "Record Route"
  8:compound_field "Stream ID"
  4:compound_field "Internet Timestamp"
}


compound_field "Security"{
            len=80
            field "Security length" {
                    len=8
                    possible_values={0x0b:"Valid"}}
            field "Security: Security"
            field "Compartments" {len=16}
            field "Handling Restrictions" {len=16}
            field "Transmission Control Code" {len=24}


            field "Security Security" {
```

FIG. 8E

```
            len=16
            possible_values={
            0:"Unclassified"
            0xf135:"Confidential"
            0x789a:" EFTO"
            0xbc4d:"MMMM"
            0x5e26:"PROG"
            0xaf13:"Restricted"
            0xd788:"Secret"
            0x6bc5:"Top Secret"
            0x35e2,0x9af1,0x4d78,0x24bd,0x135e,0x89af,0xc4d6,0xe26b:
        "Reserved for future use"
  }}
}

compound_field "Strict Source Routing" {
  len = (valueof(field "Strict Source Routing Length")-1)*8
  field "Strict Source Routing Length" {len=8 }
  field "Strict Source Routing Pointer" {len=8 minValue=4}

  repeat {
    len = (valueof(field "Strict Source Routing length")-3)*8
    field "source address" {len=32  display=ipv4}
  }
}

compound_field "Loose Source Routing"  {
  len = (valueof(field "Loose Source Routing length")-1)*8
  field "Loose Source Routing length" {len=8 }
  field "Loose Source Routing pointer" {len=8 minValue=4}
  repeat {
    len = (valueof(field "Loose Source Routing length")-3)*8
    field "source address" {len=32  display=ipv4}
  }
}

compound_field "Record Routing"  {
  len = (valueof(field "Record Routing length")-1)*8
  field "Record Routing length" {len=8 }
  field "Record Routing pointer" {len=8 minValue=4}
  repeat {
    len = (valueof(field "Record Routing length")-3)*8
    field "source address" {len=32  display=ipv4}
  }
}
```

FIG. 8F

```
    compound_field "Stream ID" {
        len = 24
        field "Stream ID length" {
           len=8
                       default=4
                       possible_values={
                             0x04:"valid"
                    }}
      field "ID" {len=16 default=4}
    }

    compound_field "Internet Timestamp" {
      field "Internet Timestamp Length" {len=8 }
      field "Internet Timestamp Pointer" {len=8 }
      field "Overflow" {
                  len=4
        desc="number of IP modules that cannot register timestamps"
                  }
      field "Flag" {
                  len=4
                  possible_values={
        0:"time stamps only, stored in consecutive 32-bit words"
        1:"each timestamp is preceded with internet address"
        3:"the internet address fields are prespecified"
      }}

    } // end of Internet Timestamp
  } // end of field "option" ----------------------------------------


} // end of field "IP" -----------------------------------------------

field "Protocol" {

len=8
default=255
field_type = mulopt_prtcl_fld
display=hex
possible_values={ //---------------------------------------------
  0:"HOPOPT (IPv6 Hop-by-Hop Option)"
  1:"ICMP (Internet Control Message)"
  2:"IGMP (Internet Group Management)"
  3:"GGP (Gateway-to-Gateway)"
  4:"IP (IP in IP encapsulation)"
  5:"ST (Stream)"
  6:"TCP"
```

FIG. 8G

```
7:"CBT"
8:"EGP (Exterior Gateway Protocol)"
9:"IGP (any private interior gateway)"
10:"BBN-RCC-MON (BBN RCC Monitoring)"
11:"NVP-II (Network Voice Protocol)"
12:"PUP"
13:"ARGUS"
14:"EMCON"
15:"XNET (Cross Net Debugger)"
16:"CHAOS"
17:"UDP"
18:"MUX (Multiplexing)"
19:"DCN-MEAS (DCN Measurement Subsystems)"
20:"HMP (Host Monitoring)"
21:"PRM (Field Radio Measurement)"
22:"XNS-IDP (XEROX NS IDP)"
23:"TRUNK-1 (Trunk-1)"
24:"TRUNK-2 (Trunk-2)"
25:"LEAF-1 (Leaf-1)"
26:"LEAF-2 (Leaf-2)"
27:"RDP (Reliable Data Protocol)"
28:"IRTP (Internet Reliable Transaction)"
29:"ISO-TP4 (ISO Transport Protocol Class 4)"
30:"NETBLT (Bulk Data Transfer Protocol)"
31:"MFE-NSP (MFE Network Services Protocol)"
32:"MERIT-INP (MERIT Internodal Protocol)"
33:"SEP ( Sequential Exchange Protocol)"
34:"3PC (Third Party Connect Protocol)"
35:"IDPR (Inter-Domain Policy Routing Protocol)"
36:"XTP (XTP)"
37:"DDP (Datagram Delivery Protocol)"
38:"IDPR-CMTP (IDPR Control Message Transport Protocol)"
39:"TP++ (TP++ Transport Protocol)"
40:"IL (IL Transport Protocol)"
41:"IPv6 (Ipv6)"
42:"SDRP (Source Demand Routing Protocol)"
43:"IPv6-Route (Routing Header for IPv6)"
44:"IPv6-Frag (Fragment Header for IPv6)"
45:"IDRP (Inter-Domain Routing Protocol)"
46:"RSVP (Reservation Protocol)"
47:"GRE (General Routing Encapsulation)"
48:"MHRP (Mobile Host Routing Protocol)"
49:"BNA"
50:"ESP (Encap Security Payload for IPv6)"
51:"AH (Authentication Header for IPv6)"
52:"I-NLSP (Integrated Net Layer Security  TUBA)"
```

FIG. 8H

53:"SWIPE (IP with Encryption)"
54:"NARP (NBMA Address Resolution Protocol)"
55:"MOBILE (IP Mobility)"
56:"TLSP (Transport Layer Security Protocol)"
57:"SKIP"
58:" IPv6-ICMP (ICMP for IPv6)"
59:"IPv6-NoNxt (No Next Header for IPv6)"
60:"IPv6-Opts (Destination Options for IPv6)"
61:"AHP (any host internal protocol)"
62:"CFTP (CFTP)"
63:"ALN (any local network)"
64:"SAT-EXPAK (SATNET and Backroom EXPAK)"
65:"KRYPTOLAN (Kryptolan)"
66:"RVD (MIT Remote Virtual Disk Protocol)"
67:"IPPC (Internet Pluribus Field Core)"
68:"ADFS (any distributed file system)"
69:"SAT-MON (SATNET Monitoring)"
70:"VISA (VISA Protocol)"
71:"IPCV (Internet Field Core Utility)"
72:"CPNX (Computer Protocol Network Executive)"
73:"CPHB (Computer Protocol Heart Beat)"
74:"WSN (Wang Span Network)"
75:"PVP (Field Video Protocol)"
76:"BR-SAT-MON (Backroom SATNET Monitoring)"
77:"SUN-ND (SUN ND PROTOCOL-Temporary)"
78:"WB-MON (WIDEBAND Monitoring)"
79:"WB-EXPAK (WIDEBAND EXPAK)"
80:"ISO-IP (ISO Internet Protocol)"
81:"VMTP"
82:"SECURE-VMTP)"
83:"VINES"
84:"TTP"
85:"NSFNET-IGP"
86:"DGP (Dissimilar Gateway Protocol)"
87:"TCF"
88:"EIGRP"
89:"OSPF"
90:"Sprite-RPC (Sprite RPC Protocol)"
91:"LARP (Locus Address Resolution Protocol)"
92:"MTP (Multicast Transport Protocol)"
93:"AX.25 (AX.25 Frames)"
94:"IPIP (IP-within-IP Encapsulation Protocol)"
95:"MICP (Mobile Internetworking Control Pro)"
96:"SCC-SP (Semaphore Communications Sec. Pro)"
97:"ETHERIP (Ethernet-within-IP Encapsulation)"
98:"ENCAP (Encapsulation Header)"

FIG. 8I

```
    99:"APES (any private encryption scheme)"
    100:"GMTP"
    101:"IFMP (Ipsilon Flow Management Protocol)]"
    102:"PNNI (PNNI over IP)"
    103:"PIM (Protocol Independent Multicast)"
    104:"ARIS"
    105:"SCPS"
    106:"QNX"
    107:"A/N (Active Networks)"
    108:"IPPCP (IP Payload Compression Protocol)"
    109:"SNP (Sitara Networks Protocol)"
    110:"Compaq-Peer (Compaq Peer Protocol)"
    111:"IPX-in-IP"
    112:"VRRP (Virtual Router Redundancy Protocol)"
    113:"PGM (PGM Reliable Transport Protocol)"
    114:"AHOP (any 0-hop protocol)"
    115-254:"Unassigned"
    255:"Reserved"
  }} // end of field "protocol" -----------------------------------------

    } // end of field "IP header" -------------------------------------


836 payload "IP Payload" {//------------------------------------------
      switch(valueof(field "Protocol")) {
838         1:protocol   "ICMP"
      2:protocol   "IGMP"
      6:protocol   "TCP"
      17:protocol   "UDP"
      46:protocol   "RSVP"
      47:protocol   "GRE"
      89:protocol   "OSPF"
      }
    } // end of packet "IP payload" ----------------------------------
  }
```

FIG. 9A

```
*/
/*******************************************************************
Constants
*******************************************************************/
//============  LCP Options=========================================
int OPT_PASSIVE   = 1;  // Don't die if we don't get a response
int OPT_RESTART = 2;    // Treat 2nd OPEN as DOWN, UP
int OPT_SILENT = 4;         // Wait for peer to speak first


//============  LCP States ==========================================
int INITIAL_STATE = 0;
int STARTING_STATE = 1;
int CLOSED_STATE = 2;
int STOPPED_STATE = 3;
int CLOSING_STATE = 4;
int STOPPING_STATE = 5;
int REQ_SENT_STATE = 6;
int ACK_RCVD_STATE = 7;
int ACK_SENT_STATE = 8;
int OPENED_STATE = 9;


//============  LCP Events  ==========================================
int UP_EVENT = 0;
int DOWN_EVENT = 1;
int OPEN_EVENT = 2;
int CLOSE_EVENT = 3;
int TIMEOUT_POS_EVENT = 4;
int TIMEOUT_NEG_EVENT = 5;
int RCV_CFG_REQ_POS_EVENT = 6;
int RCV_CFG_REQ_NEG_EVENT = 7;
int RCV_CFG_ACK_EVENT = 8;
int RCV_CFG_NACK_EVENT = 9;
int RCV_TERM_REQ_EVENT = 10;
int RCV_TERM_ACK_EVENT = 11;
int RCV_UNKN_CODE_EVENT = 12;
int RCV_CODE_REJECT_POS_EVENT = 13;
int RCV_CODE_REJECT_NEG_EVENT = 14;
int RCV_ECHO_REQ_REPLY_EVENT = 15;


//============  Transition constants================================
int TRANSITON_CNST_FALSE = 0
int TRANSITON_CNST_TRUE = 1


902~ fsm  "LCP"                                    924
     {

904~ state  INITIAL_STATE
     {
926~ UP_EVENT    -                    CLOSED_STATE
928~ OPEN_EVENT InitialStOpenEvent    STARTING_STATE

     } // INITIAL
```

FIG. 9B

```
906~state STARTING_STATE
    {

    UP_EVENT
    \
            switch(enabledSilent())
    \
            {
    \
                TRANSITON_CNST_TRUE:    StartingStUpEvEnabledSilentTRUE
    STOPPED_STATE    \
                TRANSITON_CNST_FALSE:   StartingStUpEvEnabledSilentFALSE
    REQ_SENT_STATE   \
            }
    \
    CLOSE_EVENT          -
    INITIAL_STATE

    } // STARTING

908~state CLOSED_STATE
    {
    DOWN_EVENT                     -                                  INITIAL_STATE
    OPEN_EVENT
    \
        switch(enabledSilent())
    \
        {
    \
            TRANSITON_CNST_TRUE:     ClosedStOpenEvEnabledSilentTRUE
    STOPPED_STATE       \
            TRANSITON_CNST_FALSE:    ClosedStOpenEvEnabledSilentFALSE
    REQ_SENT_STATE      \
        }
    \
    RCV_CFG_REQ_POS_EVENT        ClosedStRcvCfgReqPosEv             CLOSED_STATE
    RCV_CFG_REQ_NEG_EVENT        ClosedStRcvCfgReqNegEv             CLOSED_STATE
    RCV_CFG_ACK_EVENT            ClosedStRcvCfgAckEv                CLOSED_STATE
    RCV_CFG_NACK_EVENT           ClosedStRcvCfgNackEv               CLOSED_STATE
    RCV_CODE_REJECT_POS_EVENT    RcvCodeRejectPosEv                 CLOSED_STATE
    RCV_CODE_REJECT_NEG_EVENT    ClosedStRcvCodeRejectNegEv         CLOSED_STATE
    RCV_ECHO_REQ_REPLY_EVENT     RcvEchoReqReplyEv                  CLOSED_STATE

    } // CLOSED

910~state STOPPED_STATE
    {
    DOWN_EVENT                   StoppedStDownEv                    STARTING_STATE
    OPEN_EVENT
    \
        switch(enabledRestart())
    \
        {
    \
          TRANSITON_CNST_TRUE:  StoppedStOpenEvEnabledRestartTRUE    STOPPED_STATE
    \
```

FIG. 9C

```
      }
  \
  CLOSE_EVENT                   -                                CLOSED_STATE
  RCV_CFG_REQ_POS_EVENT         StoppedStRcvCfgReqPosEv          ACK_SENT_STATE
  RCV_CFG_REQ_NEG_EVENT         StoppedStRcvCfgReqNegEv          REQ_SENT_STATE
  RCV_CFG_ACK_EVENT             StoppedStRcvCfgAckEv             STOPPED_STATE
  RCV_CFG_NACK_EVENT            StoppedStRcvCfgNackEv            STOPPED_STATE
  RCV_CODE_REJECT_POS_EVENT     RcvCodeRejectPosEv               STOPPED_STATE
  RCV_CODE_REJECT_NEG_EVENT     StoppedStRcvCodeRejectNegEv      STOPPED_STATE
  RCV_ECHO_REQ_REPLY_EVENT      RcvEchoReqReplyEv                STOPPED_STATE

  } // STOPPED

912~state CLOSING_STATE
  {
  DOWN_EVENT                    ClosingStDownEv              INITIAL_STATE
  OPEN_EVENT                    ClosingStOpenEv              STOPPING_STATE
  TIMEOUT_POS_EVENT             ClosingStTimeoutPosEv        CLOSING_STATE
  TIMEOUT_NEG_EVENT             ClosingStTimeNegEv           CLOSED_STATE
  RCV_TERM_ACK_EVENT            ClosingStRcvTermAckEv        CLOSED_STATE
  RCV_CODE_REJECT_POS_EVENT     RcvCodeRejectPosEv           CLOSING_STATE
  RCV_CODE_REJECT_NEG_EVENT     RcvCodeRejectNegEv           CLOSED_STATE
  RCV_ECHO_REQ_REPLY_EVENT      RcvEchoReqReplyEv            CLOSING_STATE

  } // CLOSING

914~state STOPPING_STATE
  {
  DOWN_EVENT                    StoppingStDownEv             STARTING_STATE
  CLOSE_EVENT                   -                            CLOSING_STATE
  TIMEOUT_POS_EVENT             StoppingStTimeoutPosEv       STOPPING_STATE
  TIMEOUT_NEG_EVENT             StoppingStTimeNegEv          STOPPED_STATE
  RCV_TERM_ACK_EVENT            StoppingStRcvTermAckEv       STOPPED_STATE
  RCV_CODE_REJECT_POS_EVENT     RcvCodeRejectPosEv           STOPPING_STATE
  RCV_CODE_REJECT_NEG_EVENT     RcvCodeRejectNegEv           STOPPED_STATE
  RCV_ECHO_REQ_REPLY_EVENT      RcvEchoReqReplyEv            STOPPING_STATE

  } // STOPPING

916~state REQ_SENT_STATE
  {
  DOWN_EVENT                    ReqSentStDownEv            STARTING_STATE
  CLOSE_EVENT                   ReqSentStCloseEv           CLOSING_STATE
  TIMEOUT_POS_EVENT             ReqSentStTimeoutPosEv      REQ_SENT_STATE
  TIMEOUT_NEG_EVENT             ReqSentStTimeNegEv         STOPPED_STATE
  RCV_CFG_REQ_POS_EVENT         ReqSentStRcvCfgReqPosEv    ACK_SENT_STATE
  RCV_CFG_REQ_NEG_EVENT         ReqSentStRcvCfgReqNegEv    REQ_SENT_STATE
  RCV_CFG_ACK_EVENT             ReqSentStRcvCfgAckEv       ACK_RCVD_STATE
  RCV_CFG_NACK_EVENT            ReqSentStRcvCfgNackEv      REQ_SENT_STATE
  RCV_CODE_REJECT_POS_EVENT     RcvCodeRejectPosEv         REQ_SENT_STATE
  RCV_CODE_REJECT_NEG_EVENT     RcvCodeRejectNegEv         STOPPED_STATE
  RCV_ECHO_REQ_REPLY_EVENT      RcvEchoReqReplyEv          REQ_SENT_STATE

  } // REQ_SENT_STATE

918~state ACK_RCVD_STATE
```

FIG. 9D

```
{
DOWN_EVENT                     AckRcvdStDownEv             STARTING_STATE
CLOSE_EVENT                    AckRcvdStCloseEv            CLOSING_STATE
TIMEOUT_POS_EVENT              AckRcvdStTimeoutPosEv       REQ_SENT_STATE
TIMEOUT_NEG_EVENT              AckRcvdStTimeNegEv          STOPPED_STATE
RCV_CFG_REQ_POS_EVENT          AckRcvdStRcvCfgReqPosEv     OPENED_STATE
RCV_CFG_REQ_NEG_EVENT          AckRcvdStRcvCfgReqNegEv     ACK_RCVD_STATE
RCV_CFG_ACK_EVENT              AckRcvdStRcvCfgAckEv        REQ_SENT_STATE
RCV_CFG_NACK_EVENT             AckRcvdStRcvCfgNackEv       REQ_SENT_STATE
RCV_TERM_REQ_EVENT             AckRcvdStRcvTermReqEv       REQ_SENT_STATE
RCV_TERM_ACK_EVENT             -                           REQ_SENT_STATE
RCV_UNKN_CODE_EVENT            -                           ACK_RCVD_STATE
RCV_CODE_REJECT_POS_EVENT      RcvCodeRejectPosEv          REQ_SENT_STATE
RCV_CODE_REJECT_NEG_EVENT      RcvCodeRejectNegEv          STOPPED_STATE
RCV_ECHO_REQ_REPLY_EVENT       RcvEchoReqReplyEv           ACK_RCVD_STATE

} // ACK_RCVD_STATE


920~state ACK_SENT_STATE
{
DOWN_EVENT                     AckSentStDownEv             STARTING_STATE
CLOSE_EVENT                    AckSentStCloseEv            CLOSING_STATE
TIMEOUT_POS_EVENT              AckSentStTimeoutPosEv       ACK_SENT_STATE
TIMEOUT_NEG_EVENT              AckSentStTimeNegEv          STOPPED_STATE
RCV_CFG_REQ_POS_EVENT          AckSentStRcvCfgReqPosEv     ACK_SENT_STATE
RCV_CFG_REQ_NEG_EVENT          AckSentStRcvCfgReqNegEv     REQ_SENT_STATE
RCV_CFG_ACK_EVENT              AckSentStRcvCfgAckEv        OPENED_STATE
RCV_CFG_NACK_EVENT             AckSentStRcvCfgNackEv       ACK_SENT_STATE
RCV_TERM_REQ_EVENT             AckSentStRcvTermReqEv       REQ_SENT_STATE
RCV_CODE_REJECT_POS_EVENT      RcvCodeRejectPosEv          ACK_SENT_STATE
RCV_CODE_REJECT_NEG_EVENT      RcvCodeRejectNegEv          STOPPED_STATE
RCV_ECHO_REQ_REPLY_EVENT       RcvEchoReqReplyEv           ACK_SENT_STATE

} // ACK_SENT_STATE


 state OPENED_STATE
922 {
DOWN_EVENT                     OpenedStDownEv                          STARTING_STATE
OPEN_EVENT
\
    switch(enabledRestart())
\
     {
\
      TRANSITON_CNST_TRUE:     OpenedStOpenEvEnabledRestartTRUE        OPENED_STATE
\
     }
\
CLOSE_EVENT                    OpenedStCloseEv                         CLOSING_STATE
RCV_CFG_REQ_POS_EVENT          OpenedStRcvCfgReqPosEv                  ACK_SENT_STATE
RCV_CFG_REQ_NEG_EVENT          OpenedStRcvCfgReqNegEv                  REQ_SENT_STATE
RCV_CFG_ACK_EVENT              OpenedStRcvCfgAckEv                     REQ_SENT_STATE
RCV_CFG_NACK_EVENT             OpenedStRcvCfgNackEv                    REQ_SENT_STATE
RCV_TERM_REQ_EVENT             OpenedStRcvTermReqEv                    STOPPING_STATE
RCV_TERM_ACK_EVENT             OpenedStRcvTermAckEv                    REQ_SENT_STATE
```

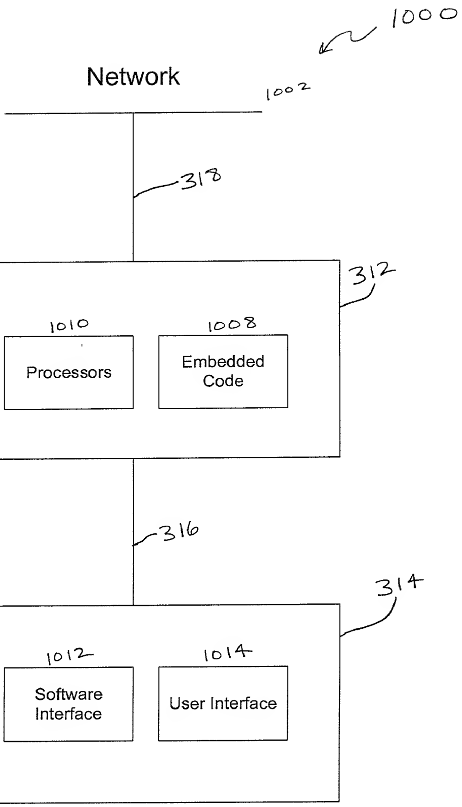
FIG. 9E

```
RCV_CODE_REJECT_POS_EVENT    RcvCodeRejectPosEv                 OPENED_STATE
RCV_CODE_REJECT_NEG_EVENT    OpenedStRcvCodeRejectNegEv         STOPPING_STATE
RCV_ECHO_REQ_REPLY_EVENT     RcvEchoReqReplyEv                  OPENED_STATE

} // OPENED_STATE


}
```

FIG. 10



1000
Network
1002
318
312
1010
Processors
1008
Embedded Code
316
314
1012
Software Interface
1014
User Interface

FIG. 11

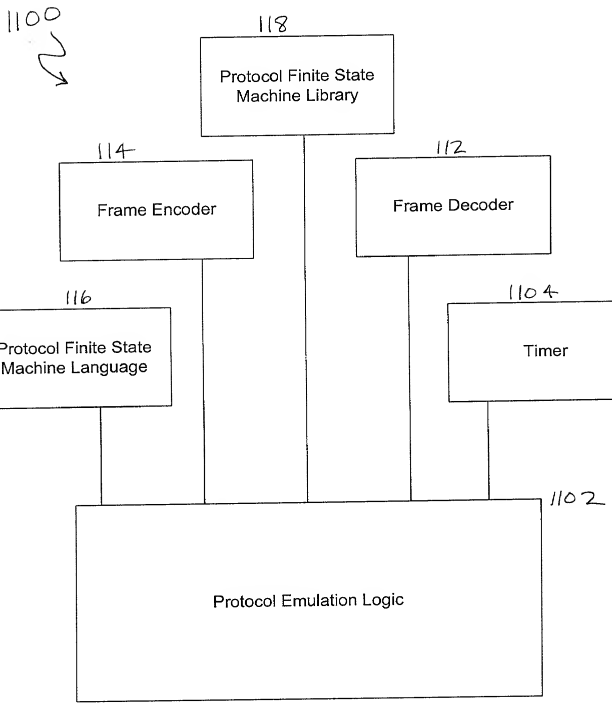

1100
118
Protocol Finite State Machine Library
114
Frame Encoder
112
Frame Decoder
116
Protocol Finite State Machine Language
1104
Timer
1102
Protocol Emulation Logic

FIG. 12A

1202

	State					
	0	1	2	3	4	5
Events	Initial	Starting	Closed	Stopped	Closing	Stopping
Up	2	tc1,6	–	–	–	–
Down	–	–	0	1	0	1
Open	1	1	tc1,3/tc2,6	tc3,3r	5r	5r
Close	0	0	2	2	4	4
TO+	–	–	–	–	4	5
TO-	–	–	–	–	2	3
RCR+	–	–	2	8	4	5
RCR-	–	–	2	6	4	5
RCA	–	–	2	3	4	5
RCN	–	–	2	3	4	5
RTR	–	–	2	3	4	5
RTA	–	–	2	3	2	3
RUC	–	–	2	3	4	5
RXJ+	–	–	2	3	4	5
RXJ-	–	–	2	3	2	3
RXR	–	–	2	3	4	5

FIG. 12B

1204

	State 6	7	8	9
Events	Req-Sent	Ack-Rcvd	Ack-Sent	Opened
Up	-	-	-	-
Down	1	1	1	1
Open	6	7	8	tc3,9r
Close	4	4	4	4
TO+	6	6	8	-
TO-	3p	3p	3p	-
RCR+	8	9	8	8
RCR-	6	7	6	6
RCA	7	6	9	6
RCN	6	6	8	6
RTR	6	6	6	5
RTA	6	6	8	6
RUC	6	7	8	9
RXJ+	6	6	8	9
RXJ-	3	3	3	5
RXR	6	7	8	9

```
[p]    Passive option
[r]    Restart option
[s]    Silent option

// Transition conditions
tc1 -   (enabledSilent() == TRUE)
tc2 -   (enabledSilent() == FALSE)
tc3 -   (enabledRestart() == TRUE)
```

09840443.042301

FIG. 13

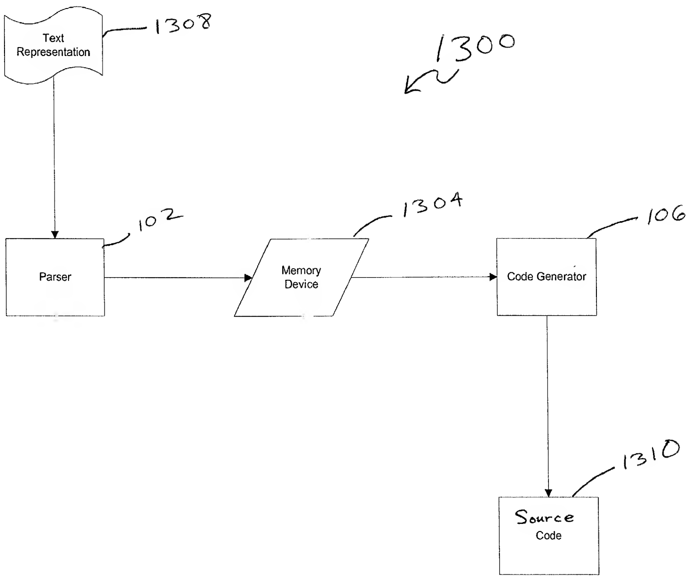
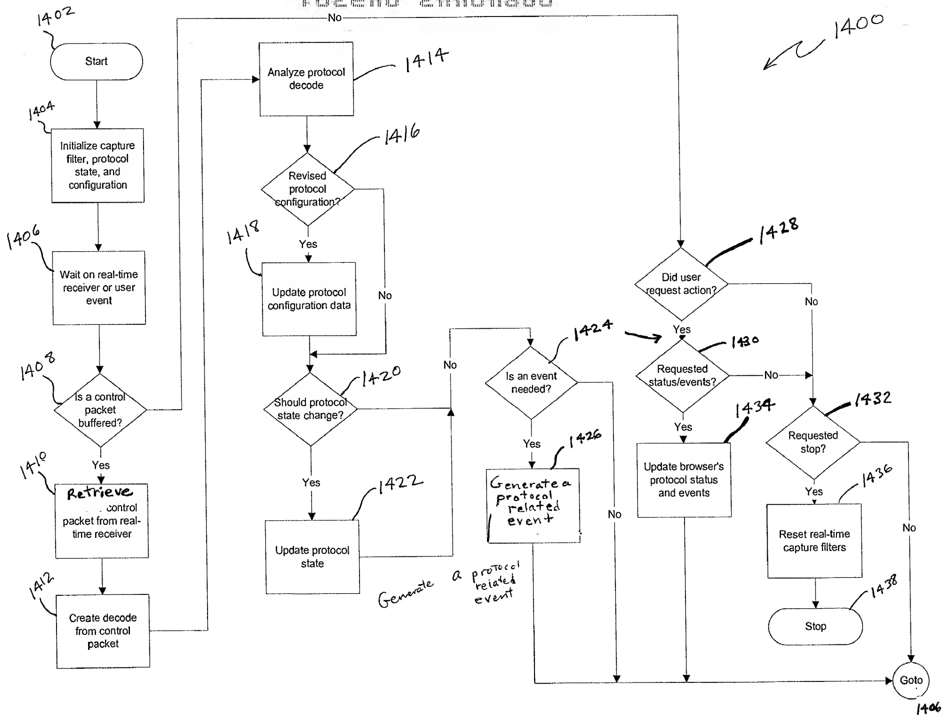


FIG. 14



1400
1402
Start
1404
Initialize capture filter, protocol state, and configuration
1406
Wait on real-time receiver or user event
1408
Is a control packet buffered?
Yes
No
1410
Retrieve control packet from real-time receiver
1412
Create decode from control packet
1414
Analyze protocol decode
1416
Revised protocol configuration?
Yes
No
1418
Update protocol configuration data
1420
Should protocol state change?
Yes
No
1422
Update protocol state
Generate a protocol related event
1424
Is an event needed?
Yes
No
1426
Generate a protocol related event
1428
Did user request action?
Yes
No
1430
Requested status/events?
Yes
No
1434
Update browser's protocol status and events
1432
Requested stop?
Yes
No
1436
Reset real-time capture filters
1438
Stop
Goto
1406

FIG. 15

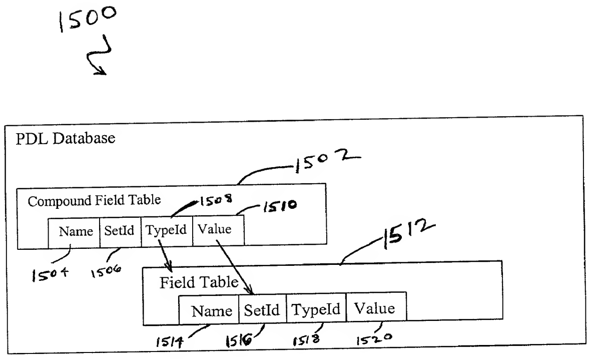

1500
PDL Database
1502
Compound Field Table
1508
1510
Name
SetId
TypeId
Value
1504
1506
1512
Field Table
Name
SetId
TypeId
Value
1514
1516
1518
1520

FIG. 16

1600

1602 1604 1606 1608

1610

TypeId	TypeName	TableName	Type	Comment
0	Start		Control	
0	ProtocolNames	ProtocolNames		
1	Protocol	Protocol	Compound	
2	Header	Header	Compound	
3	Payload	Payload	Compound	
4	Trailer	Trailer	Compound	
5	CompoundField	CompoundField	Compound	
6	Repeat	Repeat	Compound	
7	Switch	Switch	Compound	
8	PossibleValues	PossibleValues	Attribute	
9	Field	Field	Simple	
10	Len	Len	Attribute	
11	MinLen	Len	Attribute	
12	MaxLen	Len	Attribute	
13	Display	Display	Attribute	
14	Encode	Encode	Attribute	
15	Default	Default	Attribute	
16	Break	Len	Attribute	
17	Optional	Len	Attribute	
18	Offset	Len	Attribute	
19	Name	Name	Attribute	
20	Description	Description	Attribute	
21	String	String		
22	End	End	Control	
23	DecisiveField	Field	Simple	
24	FieldType	Attribute	Attribute	
28	MinVal	Attribute	Attribute	
29	MaxVal	Attribute	Attribute	
30	Count	Len	Attribute	

1612

FIG. 17

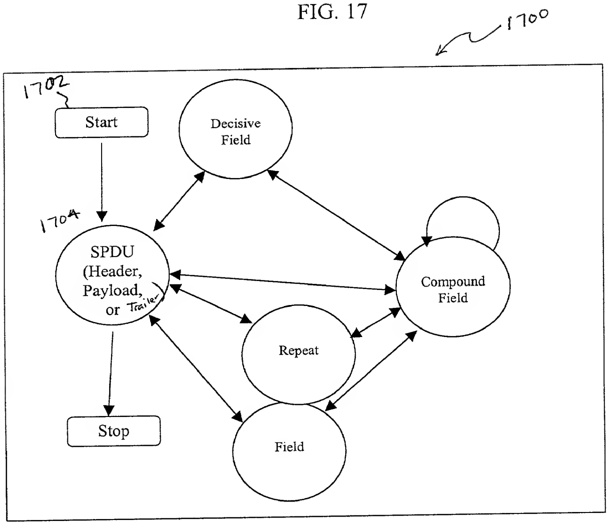
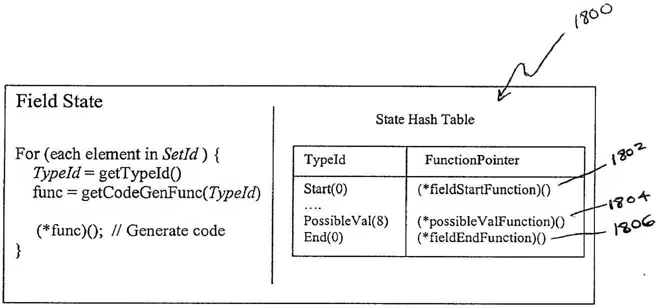

1700
1702
Start
Decisive Field
1704
SPDU (Header, Payload, or Trailer)
Compound Field
Repeat
Stop
Field

FIG. 18



Field State

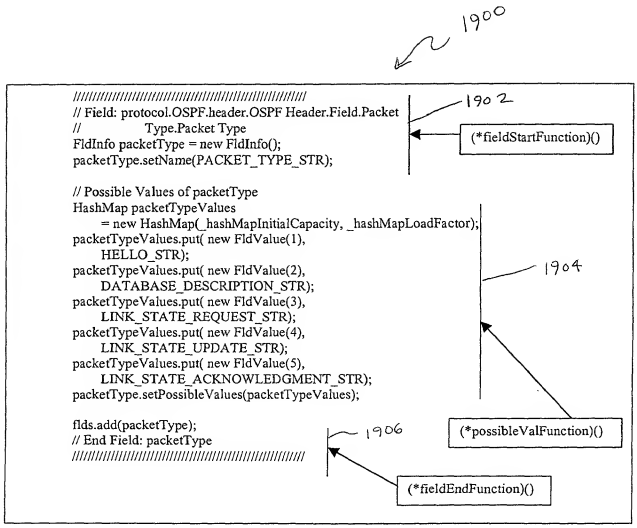
```
For (each element in SetId ) {
    TypeId = getTypeId()
    func = getCodeGenFunc(TypeId)

    (*func)();  // Generate code
}
```

State Hash Table

TypeId	FunctionPointer
Start(0)	(*fieldStartFunction)()
....	
PossibleVal(8)	(*possibleValFunction)()
End(0)	(*fieldEndFunction)()

FIG. 19

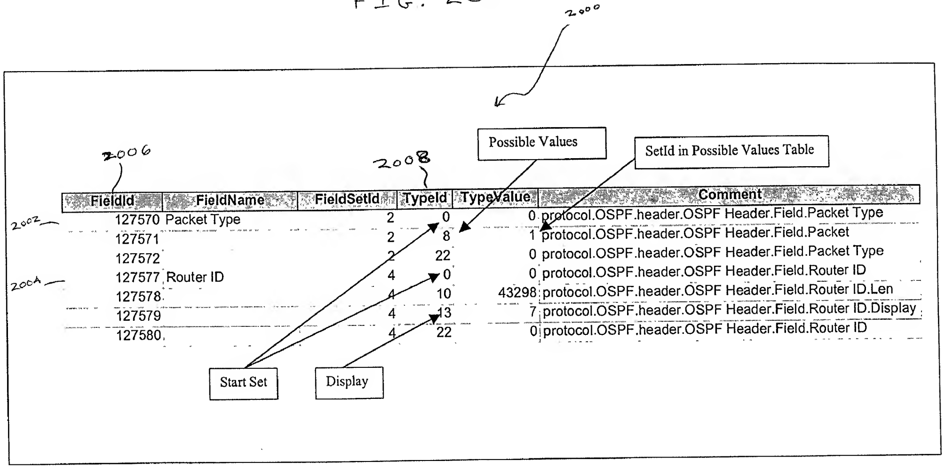


```
////////////////////////////////////////////////////////////
// Field: protocol.OSPF.header.OSPF Header.Field.Packet
//              Type.Packet Type
FldInfo packetType = new FldInfo();
packetType.setName(PACKET_TYPE_STR);

// Possible Values of packetType
HashMap packetTypeValues
      = new HashMap(_hashMapInitialCapacity, _hashMapLoadFactor);
packetTypeValues.put( new FldValue(1),
      HELLO_STR);
packetTypeValues.put( new FldValue(2),
      DATABASE_DESCRIPTION_STR);
packetTypeValues.put( new FldValue(3),
      LINK_STATE_REQUEST_STR);
packetTypeValues.put( new FldValue(4),
      LINK_STATE_UPDATE_STR);
packetTypeValues.put( new FldValue(5),
      LINK_STATE_ACKNOWLEDGMENT_STR);
packetType.setPossibleValues(packetTypeValues);

flds.add(packetType);
// End Field: packetType
////////////////////////////////////////////////////////////
```

FIG. 20


2000
Possible Values
SetId in Possible Values Table
2006
2008
2002
2004
Start Set
Display

FieldId	FieldName	FieldSetId	TypeId	TypeValue	Comment
127570	Packet Type	2	0	0	protocol.OSPF.header.OSPF Header.Field.Packet Type
127571		2	8	1	protocol.OSPF.header.OSPF Header.Field.Packet
127572		2	22	0	protocol.OSPF.header.OSPF Header.Field.Packet Type
127577	Router ID	4	0	0	protocol.OSPF.header.OSPF Header.Field.Router ID
127578		4	10	43298	protocol.OSPF.header.OSPF Header.Field.Router ID.Len
127579		4	13	7	protocol.OSPF.header.OSPF Header.Field.Router ID.Display
127580		4	22	0	protocol.OSPF.header.OSPF Header.Field.Router ID

FIG. 21

Protocol	Status	Time	Mode
LCP	Open	09/04/00 08:01:03 AM	Emulate
IPCP	Negotiating	09/04/00 08:01:07 AM	Monitor
MPLSCP	Closed	09/04/00 08:01:05 AM	Monitor
RSVP	N/a	09/04/00 08:01:00 AM	Disabled

FIG. 22

	Rx1	Rx2
Current Status	Open	Negotiating
Loop-back	No	No
Unanswered Echo Requests	0	0
Maximum Receive Unit	512	1500
Asynchronous Character Map	0	0
Authentication Protocol	Unknown	Unknown
Quality Protocol	N/a	N/a
Protocol Field Compression	Off	Off
Address/Control Field Compression	Off	Off
Magic Number	0xFF	0x1FF
FCS Alternative	CCITT 32-bit	CCITT 32-bit

FIG. 23

Time	Recvr	Protocol	MsgType	Event	Synopsis
09/04/00 08:01:01 AM	Rx1	LCP	ConfigReq	Protocol Negotiating	ACComp:On,Pcomp:On,Magic:0x1ab82049
09/04/00 08:01:01 AM	Rx2	LCP	ConfigAck	Open Protocol	ACComp:On,Pcomp:On,Magic:0x4e3d9123
09/04/00 08:01:02 AM	Rx2	LCP	ConfigReq	Protocol Negotiating	ACComp:On,Pcomp:On,Magic:0x1ab82049
09/04/00 08:01:03 AM	Rx1	LCP	ConfigAck	Open Protocol	ACComp:On,Pcomp:On,Magic:0x1ab82049
09/04/00 08:01:04 AM	Rx2	IPCP	ConfigReq	Protocol Negotiating	Local IP: 198.85.38.199
09/04/00 08:01:06 AM	Rx1	IPCP	ConfigAck	Open Protocol	Local IP: 198.85.38.199
09/04/00 08:01:06 AM	Rx1	IPCP	ConfigReq	Protocol Negotiating	Local IP: 198.85. 34.45
09/04/00 08:01:06 AM	Rx2	IPCP	ConfigAck	Open Protocol	Local IP: 198.85. 34.45
09/04/00 08:01:10 AM	Rx2	MPLSCP	ConfigReq	Protocol Negotiating	
09/04/00 08:01:12 AM	Rx2	MPLSCP	TermReq	Close Protocol	
09/04/00 08:11:01 AM	Rx1	RSVP	Rx1	Rx1	Resv Request <session: 198.85.34.45 UDP port 14>
09/04/00 08:11:03 AM	Rx1	RSVP	Rx1	Rx1	Resv Confirm <session: 198.85.34.45 UDP port 14>
09/04/00 08:11:04 AM	Rx2	RSVP	Rx2	Rx2	Path Request <session: 198.85.38.199 UDP port 0x82A>
09/04/00 08:11:06 AM	Rx1	RSVP	Rx1	Rx1	Resv Error <session: 198.85. 38.199 UDP port 0x82A>
09/04/00 09:21:10 AM	Rx2	RSVP	Rx2	Rx2	Path Request <session: 198.85. 38.199 UDP port 0x82A>
09/04/00 09:21:12 AM	Rx2	RSVP	Rx2	Rx2	Resv Confirm <session: 198.85. 38.199 UDP port 0x82A>
09/04/00 09:21:30 AM	Rx1	RSVP	Rx1	Rx1	Path Tear <session: 198.85.34.45 UDP port 14>
09/04/00 09:21:32 AM	Rx2	RSVP	Rx2	Rx2	Resv Tear <session: 198.85.34.45 UDP port 14>
09/04/00 09:21:32 AM	Rx2	RSVP	Rx2	Rx2	Resv Tear <session: 198.85.34.45 UDP port 14>
09/04/00 11:44:30 PM	Rx1	IPCP	TermReq	Close Protocol	
09/04/00 11:44:31 PM	Rx1	IPCP	TermAck	Close Protocol	
09/04/00 11:44:32 PM	Rx1	LCP	TermReq	Close Protocol	
09/04/00 11:44:33 PM	Rx2	LCP	TermAck	Close Protocol	